INDIAN CREEK AND INDIAN CREEK RESERVOIR TMDL FOR TEMPERATURE

SUBSEGMENT 060206

US EPA Region 6

With cooperation from the
Louisiana Department of Environmental Quality
Office of Environmental Assessment
Environmental Technology Division

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EXECUTIVE SUMMARY

Section 303(d) of the Federal Clean Water Act requires states to identify water bodies that are not meeting water quality standards and to develop total maximum daily pollutant loads for those water bodies. A total maximum daily load (TMDL) is the amount of a pollutant that a water body can assimilate without exceeding the established water quality standard for that pollutant. Through a TMDL, pollutant loads can be distributed or allocated to point sources and nonpoint sources discharging to the water body. A TMDL has been developed for temperature for Indian Creek Reservoir.

Indian Creek Reservoir is an impoundment of approximately 2250 acres on Indian Creek, located near the town of Woodworth, approximately 10 miles south of Alexandria. Indian Creek flows in a generally southerly direction, to a confluence with Bayou Boeuf segment 060208. Indian Creek and Indian Creek Reservoir segment 060206 was listed on both the 1998 and the October 28, 1999 Court Ordered §303(d) Lists as not fully supporting water quality standards due to exceedances of maximum temperature from a single sampling site on the reservoir from June through August 1998, and was ranked as high priority for TMDL development. Louisiana's water quality standard for temperature is applied as follows:

> "The temperature criteria enumerated in the tables in most cases represent maximum values obtained from existing data. In a few cases, however, a limited number of unusually high temperatures in the range of 35 °C to 36 °C (95 - 97 °F) have been deleted because these values are believed to have been recorded during conditions of unseasonably high temperatures and/or unusually low flows or water levels and therefore do not represent normal maximum temperatures.
>
> The criteria consists of two parts, a temperature differential and a maximum temperature. The temperature differential represents the maximum permissible increase above ambient conditions after mixing. No additional process heat shall be added once the ambient temperature reaches the maximum temperature specified in the standards, except under natural conditions such as unusually hot, dry weather, as provided for in Subsection C.4.b.i - ii of this Section."

Louisiana's water quality standard for maximum temperature for the Indian Creek and Indian Creek Reservoir (Subsegment 060206) is listed in Table 3 of Louisiana's Water Quality Standards as 32 °C. The designated uses for the Indian Creek and Indian Creek Reservoir are: (A) primary contact recreation; (B) secondary contact recreation; (C) propagation of fish and wildlife; and (D) drinking water supply. The TMDL was developed based on simple heat balance calculations using the reservoir volume at conservation pool elevation (surface area = 2250 acres and average depth = 9.0 feet). The TMDL calculation includes a wasteload allocation, a load allocation, and a margin of safety. A 3.2% reduction in heat (temperature) load will be needed to meet the maximum temperature standard of 32 °C for the propagation of fish and wildlife and other designated uses for this subsegment.

1. Introduction

Indian Creek and Indian Creek Reservoir segment 060206 was listed on both the 1998 and the October 28, 1999 Court Ordered §303(d) Lists as not fully supporting the water quality standard for maximum temperature. Segment 060206 was ranked as high priority (ranking of 1) on the 1998 List. A TMDL for temperature was developed in accordance with the requirements of Section 303 of the federal Clean Water Act. The purpose of a TMDL is to determine the pollutant loading that a waterbody can assimilate without exceeding the water quality standard for that pollutant; the TMDL also establishes the load reduction that is necessary to meet the standard in a waterbody. The TMDL consists of the wasteload allocation (WLA), the load allocation (LA), and a margin of safety (MOS). The wasteload allocation is the load allocated to point sources of the pollutant of concern, and the load allocation is the load allocated to nonpoint sources. The margin of safety is a percentage of the TMDL that accounts for the uncertainty associated with the model assumptions, data inadequacies, and growth.

2. Study Area Description

2.1 Indian Creek and Indian Creek Reservoir, Segment 060206

Indian Creek and Indian Creek Reservoir are located within basin/segment 0602 in south central Louisiana (LDEQ,1987). Indian Creek flows in a generally southerly direction, to a confluence with Bayou Boeuf (segment 060208). Most of the area of the Indian Creek watershed lies within the natural flood plain of the Red River. The Red River is now leveed, eliminating the potential for a natural flow of water from the river into any of the streams in Segment 0602. The surface area of Indian Creek watershed is 24.79 square miles, and is completely contained within the Alexander State Forest. Indian Creek Reservoir was impounded in 1970, with a maximum depth of 25 feet, and an average depth of 9 feet. This reservoir is under the jurisdiction of the Rapides Parish Police Jury, which regulates water level and allocates irrigation water downstream via a bottom withdrawal outlet structure at the dam. The State operates a fish hatchery adjacent to the reservoir; however, this is not a feed-out facility and discharge impacts to the reservoir have been determined to be negligible. The State has determined that a permit is not necessary for this facility.

The Indian Creek watershed is entirely contained within the Alexander State Forest. Land use in the Indian Creek watershed within water quality basin 0602 is predominately forest, with the Alexandria urban area located to the north, outside of this watershed. Suburban communities have developed in the agricultural lands immediately south and west of Alexandria. The major land uses for the basin are listed in Table 1 (LDEQ, 1993).

Table 1. Land Use (acres) in Segment 0602: Vermilion-Teche Basin

SEGMENT	AGRICULTURE	URBAN	WETLAND	FOREST
0602	676,490 (64.1%)	46,942 (4.5%)	73,230 (6.9%)	245,115 (23.2%)

2.2 Water Quality Standards

The designated uses for Indian Creek and Indian Creek Reservoir include both primary contact recreation and secondary contact recreation, propagation of fish and wildlife, and drinking water supply. As part of State Water Quality Standards, a maximum temperature criterion of 32 degrees C has been established for Indian Creek and Indian Creek Reservoir. This water body is listed because greater than 30% of the measurements (5 out of 12) taken at the same site in the reservoir from June through August 1998 exceeded the temperature criterion.

2.3 Identification of Sources

The sources identified in the *1998 Louisiana Water Quality Inventory* (LDEQ,1998) as affecting the water quality of Indian Creek and Indian Creek Reservoir are designated as "Other" (natural sources).

2.3.1 Point Sources

There are no point source discharges of thermal load to this segment. The wasteload allocation will be set to zero.

2.3.2 Nonpoint Sources

All thermal loading for temperature in this subsegment is attributed to nonpoint sources. (LDEQ, 1993)

3. TMDL Load Calculations

3.1 Current Load Evaluation

TMDL Parameter: Temperature

Water quality data location: LDEQ WQ station #0666, Indian Creek Reservoir, Louisiana.
Period of record: June 17, 1998 through December 2, 1998.

At station #0666, 5 of 12 data points exceeded the maximum temperature standard of 32 °C

Average Temperature (June through August, 1998) at station #0666 = 33 °C

For the current load calculation, we will use the average temperature (33 °C).

Average Streamflow: Using USGS gage data on Bayou Courtableau near Washington (#07382500) of 1.56 cfs per square mile, and a drainage area of 24.79 square miles, the average streamflow is estimated as 38.67 cfs. We assume that the headwater inflow volume is equal to the downstream outflow.

The current heat load is calculated using the reservoir volume at conservation pool elevation (surface area = 2250 acres and average depth = 9 feet) and average water temperature (33 °C) recorded June through August of 1998.

Equation 1:
Current Heat Load = V * Rho * Cp * Tavg

Where: V = Volume at conservation pool elevation in cubic meters
= (Surface Area x Depth)
= (2250 acres * 4046.8m^2/acre) * (9 ft * 0.3048m/ft)
= 24,977,658.96 cubic meters/day;
Rho = Density of water (998.2 kg/cubic meter);
Cp = Specific heat of water (4182 J/kg °C);
Tavg = Average Temperature recorded (June- August) in °C;
= 33 °C

Current Heat load = 24,977,658.96 * 998.2 * 4182 * 33 = 3.44E15 J/day.

3.2 TMDL

The Total Maximum Daily Load (TMDL) is calculated using the maximum water temperature standard (32 °C) in Equation 1. We assumed that the upstream inflow water volume to the reservoir is equal to the downstream outflow water volume from the reservoir.

TMDL = V * Rho * Cp * Tmax where
Tmax = 32 °C

TMDL = 24,977,658.96 * 998.2 * 4182 * 32
= 3.33E15 J/day

Heat Load Reduction = Current Heat Load - TMDL
= 3.44E15 - 3.33E15
= 0.11E15 J/day

% Heat Load Reduction = Heat load Reduction/Current Heat Load
= 0.11E15 / 3.44E15
= 3.2 %

3.3 Wasteload Allocation (WLA)

There are no point source discharges of thermal load to this segment. The WLA was set to zero.

3.4 Load Allocation (LA)

The load allocation for the dry season (June - August, 1998) using the reservoir volume at conservation pool elevation (surface area = 2250 acres and average depth = 9 feet) and the maximum water temperature standard (32 °C) is calculated as:

(TMDL@ given volume and criterion) - (WLA)= LA

LA for June - August season at reservoir volume of 24,977,658.96 cubic meters/day

= 3.33E15 J/day (TMDL@ 24,977,658.96 cubic meters/day) – 0.00 J/day (WLA)

= 3.33E15 J/day

3.5 Seasonal Variability

While Louisiana has not established a seasonal water quality criterion for maximum temperature, it appears that temperature elevation in the absence of thermal discharges is probably a seasonal (summer) occurrence, exacerbated by recent drought conditions and unusually high ambient temperatures.

3.6 Margin of Safety (MOS)

The Clean Water Act requires that TMDLs take into consideration a margin of safety. EPA guidance allows for the use of implicit or explicit expressions of the margin of safety or both. When conservative assumptions are used in the development of the TMDL or conservative factors are used in the calculations, the margin of safety is implicit. When a percentage of the load is factored into the TMDL calculation as a margin of safety, the margin of safety is explicit. The conservative assumptions are:

- Using reservoir volume at conservation pool elevation to calculate current load and load reduction.
- Using water density of 998.2 kg/cubic meter at 25 °C.
- Using specific heat of water value of 4182 J/kg °C.

4. Other Relevant Information

Although not required by this TMDL, LDEQ utilizes funds under Section 106 of the federal Clean Water Act and under the authority of the Louisiana Environmental Quality Act to operate an established program for monitoring the quality of the state's surface waters. The LDEQ Surveillance Section collects surface water samples at various locations, utilizing appropriate sampling methods and procedures for ensuring the quality of the data collected. The objectives of the surface water monitoring program are to determine the quality of the state's surface

waters, to develop a long-term data base for water quality trend analysis, and to monitor the effectiveness of pollution controls. The data obtained through the surface water monitoring program is used to develop the state's biennial 305(b) report (*Water Quality Inventory*) (LDEQ, 1996, 1998) and the 303(d) list of impaired waters. This information is also utilized in establishing priorities for the LDEQ nonpoint source program.

The LDEQ has implemented a watershed approach to surface water quality monitoring. Through this approach, the entire state is sampled over a five-year cycle with two targeted basins sampled each year. Long-term trend monitoring sites at various locations on the larger rivers and Lake Pontchartrain are sampled throughout the five-year cycle. Sampling is conducted on a monthly basis or more frequently if necessary. Sampling sites are located where they are considered to be representative of the water body. Under the current monitoring schedule, targeted basins follow the TMDL priorities. In this manner, the first TMDLs will have been established by the time the first priority basins are monitored again in the second five-year cycle. This will allow the LDEQ to determine whether there has been any improvement in water quality following establishment of the TMDLs. As the monitoring results are evaluated at the end of each year, water bodies may be added to or removed from the 303(d) list. The sampling schedule for the first five-year cycle is shown below. The Vermilion-Teche River Basin will be sampled again in 2003.

1998 – Mermentau and Vermilion-Teche River Basins
1999 - Calcasieu and Ouachita River Basins
2000 – Barataria and Terrebonne Basins
2001 – Lake Pontchartrain Basin and Pearl River Basin
2002 – Red and Sabine River Basins

(Atchafalaya and Mississippi Rivers will be sampled continuously.)

In addition to ambient water quality sampling in the priority basins, the LDEQ has increased compliance monitoring in those basins, following the same schedule. Approximately 1,000 to 1,100 permitted facilities in the priority basins were targeted for inspections. The goal set by LDEQ was to inspect all of those facilities on the list and to sample 1/3 of the minors and 1/3 of the majors. During 1998, 476 compliance evaluation inspections and 165 compliance sampling inspections were conducted throughout the Mermentau and Vermilion-Teche River Basins.

5. Public Participation

When EPA establishes a TMDL, 40 C.F.R. § 130.7(d)(2) requires EPA to publicly notice and seek comment concerning the TMDL. Pursuant to an October 1, 1999, Court Order, EPA prepared this TMDL. After submission of this TMDL to the Court, EPA commenced preparation of a notice seeking comments, information and data from the general and affected public. Comments and additional information were submitted during the public comment period and this Court Ordered TMDL was revised accordingly. EPA has transmitted this revised TMDL to the Court, and to the Louisiana Department of Environmental Quality (LDEQ) for incorporation into LDEQ's current water quality management plan.

REFERENCES

LDEQ, 1987. Louisiana Department of Environmental Quality. *State of Louisiana Water Quality Management Plan, Volume 4: Boundaries and Inventories*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.

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LDEQ, 1996. *State of Louisiana Water Quality Management Plan, Volume 5, Part B: Water Quality Inventory*. Louisiana Department of Environmental Quality, Office of Water Resources, Baton Rouge, La.

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LDEQ, 2001. http://www.deq.state.la.us/surveillance/wqdata/0666wqnf.txt

USEPA, 1985. U.S. Environmental Protection Agency. *Water Quality Assessment*: *A Screening Procedure for Toxic and Conventional Pollutants in Surface and Ground Water*, Part I (Revised 1985), EPA/600/6-85/002a, September 1985 Revised.

APPENDIX A Temperature data

Indian Creek Reservoir

Date	Time	Depth (m)	Water Temperature (0C)
6/17/98	1245	1.0	32.12
7/08/98	1330	1.0	34.41
7/22/98	1310	1.0	33.28
8/05/98	1130	1.0	32.50
8/19/98	1335	1.0	32.50
9/02/98	1200	1.0	31.82
9/28/98	1230	1.0	30.34
10/07/98	1125	1.0	26.42
10/21/98	1110	1.0	24.22
11/05/98	1225	1.0	21.13
11/18/98	1139	1.0	18.02
12/02/98	1235	1.0	20.22

Data Source: http://www.deq.state.la.us/surveillance/wqdata/0666wqnf.txt

Dry season (June - August) 1998 average temperature = 33.0 °C.

APPENDIX B Dischargers in subsegment.

There are no known thermal dischargers on this subsegment.

APPENDIX C Flow Information

Average Streamflow: Using the USGS gage (#07382500) on Bayou Courtableau near Washington, a runoff rate of 1.56 cfs per square mile, and a drainage area of 24.79 square miles, the average streamflow is estimated to be 38.67 cfs.